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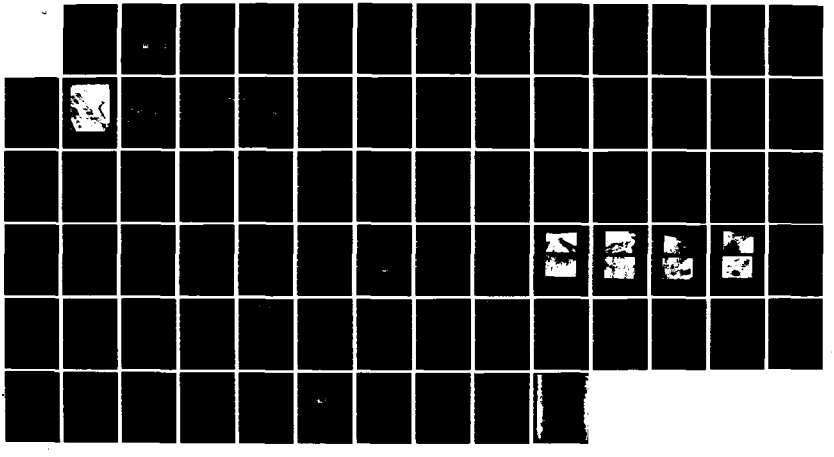

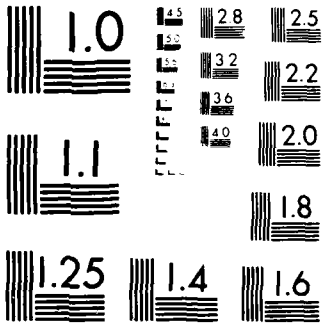

QUINNIPIAC RIVER BASIN
HAMDEN, CONNECTICUT

LAKE WINTERGREEN DAM
CT 00118

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

AUGUST 1978

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Quinnipiac River Basin
Hamden, Conn.
Lake Wintergreen Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam consists of two sections. The portion of the dam from the spillway 185 ft. to the left is an earthen embankment on the upstream side of a rubble masonry retaining wall. The remaining portion of the dam to the left of the retaining wall is an earthen embankment. According to the existing information, a rubble masonry corewall exists from the spillway 260 ft. to the left. The corewall is 3.5 ft. wide at the top and has both upstream and downstream faces battered approx. 1 /4 in 12. The dam is approx. 900± ft. in length and rises approx. 31± ft. above the elevation of the original streambed.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED

DEC 22 1978

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

I am forwarding to you a copy of the Lake Wintergreen Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, The New Haven Water Company, Sargent Drive, New Haven, Connecticut 06506, ATTN: Mr. Jack Reynolds, Superintendent, Source of Supply.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

LAKE WINTERGREEN DAM

CT 00118

QUINNIPIAC RIVER BASIN
HAMDEN, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT

PHASE I INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

Name of Dam:	LAKE WINTERGREEN
Inventory Number:	CT 00118
State Located:	CONNECTICUT
County Located:	NEW HAVEN
Town Located:	HAMDEN
Stream:	WINTERGREEN BROOK
Owner:	NEW HAVEN WATER COMPANY
Date of Inspection:	JUNE 6, 1978
Inspection Team:	PETER HEYNEN
	MIKE HORTON
	GONZALO CASTRO

The dam consists of two sections. The portion of the dam from the spillway 185 feet to the left is an earthen embankment on the upstream side of a rubble masonry retaining wall. The remaining portion of the dam to the left of the retaining wall is an earthen embankment. According to the existing information, a rubble masonry corewall exists from the spillway 260 feet to the left. The corewall is 3.5 feet wide at the top and has both upstream and downstream faces battered approximately 1 /4 in 12. The dam is approximately 900± feet in length and rises approximately 31± feet above the elevation of the original streambed. The top of the dam varies in width from 20 feet (typical) to a maximum of 60 feet. The spillway is reported as a 50-foot-wide concrete weir flow ing to a steep channel cut into natural rock formations. A 16 inch diameter high level intake approximately 900± feet to the right of the dam was used as a supply main. The supply main is operable, however the reservoir is not used as a water supply due to the turbidity and poor color quality of the water. A 12 inch, low level inlet passes through the dam, but is presently inoperable.

The area immediately below the dam is a residential area with single family homes. Interstate Route 15 is also in the vicinity of the dam further downstream.

Based upon visual inspections at the site and past performance history, the dam is judged to be in fair condition. No evidence of structural instability in the retaining wall or the embankment portions of the dam was observed. However, the masonry retaining wall is very irregular making it impossible to detect any misalignment or movement of the wall. There are areas requiring attention.

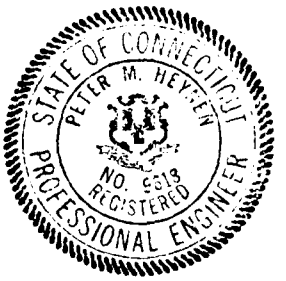
Based upon the size (Small) and hazard classification (High) in accordance with Corps guidelines, the Test Flood will be equal to the Probable Maximum Flood (PMF). Based upon our hydraulic computations, the spillway capacity is 850 cubic feet per second, which is equivalent to approximately 28 percent of the Test Flood. Peak inflow to the reservoir is 3,500 cubic feet per second; peak outflow (Test Flood) is 3,000 cubic feet per second with the dam overtopped 0.8 feet. The peak failure outflow from the dam breaching would be 80,400 cubic feet per second. A breach of the dam would develop a 20 foot wave downstream of the dam causing flooding and severe loss of life and damage to property.

It is recommended that a more refined hydraulic/hydrologic study be undertaken to determine the best way to increase the ability of the facility to pass a greater percentage of the Test Flood.

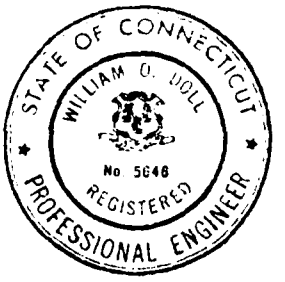
Studies should also be performed to determine whether seepage through the earthen embankment is of a high enough volume and serious enough nature to warrant the installation of drains at the toe of the downstream face of the embankment. To facilitate this determination, vegetation should be removed from the downstream face of the dam. Monitoring of the various seeps should be instituted to determine the quantity and turbidity of the seeps, and to guard against any substantial increases in the quantity and turbidity of the seeps going unnoticed.

An operation and maintenance plan should be instituted as described in Section 7.

The above recommendations and remedial measures should be instituted within 6 months of the owner's receipt of this Phase I Inspection Report.



Peter M. Heynen, P.E.
Project Manager
Cahn Engineers, Inc.



William O. Doll, P.E.
Chief Engineer
Cahn Engineers, Inc.

This Phase I Inspection Report on Lake Wintergreen Dam has been has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionarly in nature. It would be incorrect to assume that the present condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions there of. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as neccessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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Lake Wintergreen Dam - Inventory No. CT 00118		E-1

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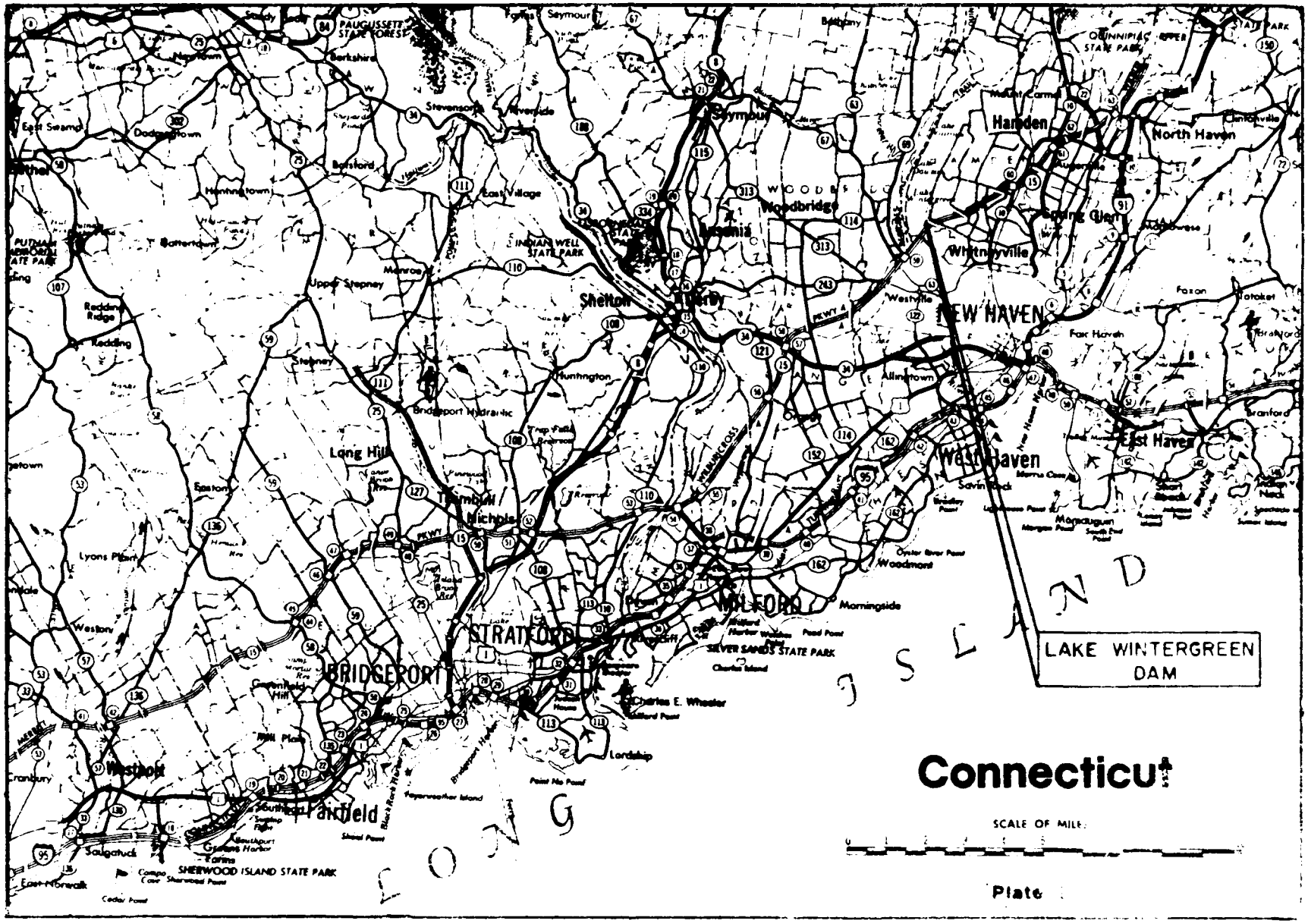
Availability of Data

OVERVIEW PHOTO

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	LAKE WINTERGREEN DAM
CAHN ENGINEERS INC. WALLINGFORD, CONN. ARCHITECT—— ENGINEER	INSPECTION OF NON-FED. DAMS	WINTERGREEN BROOK HAMDEN, CONNECTICUT CE # 27 531 GE DATE 6/6/78 PAGE X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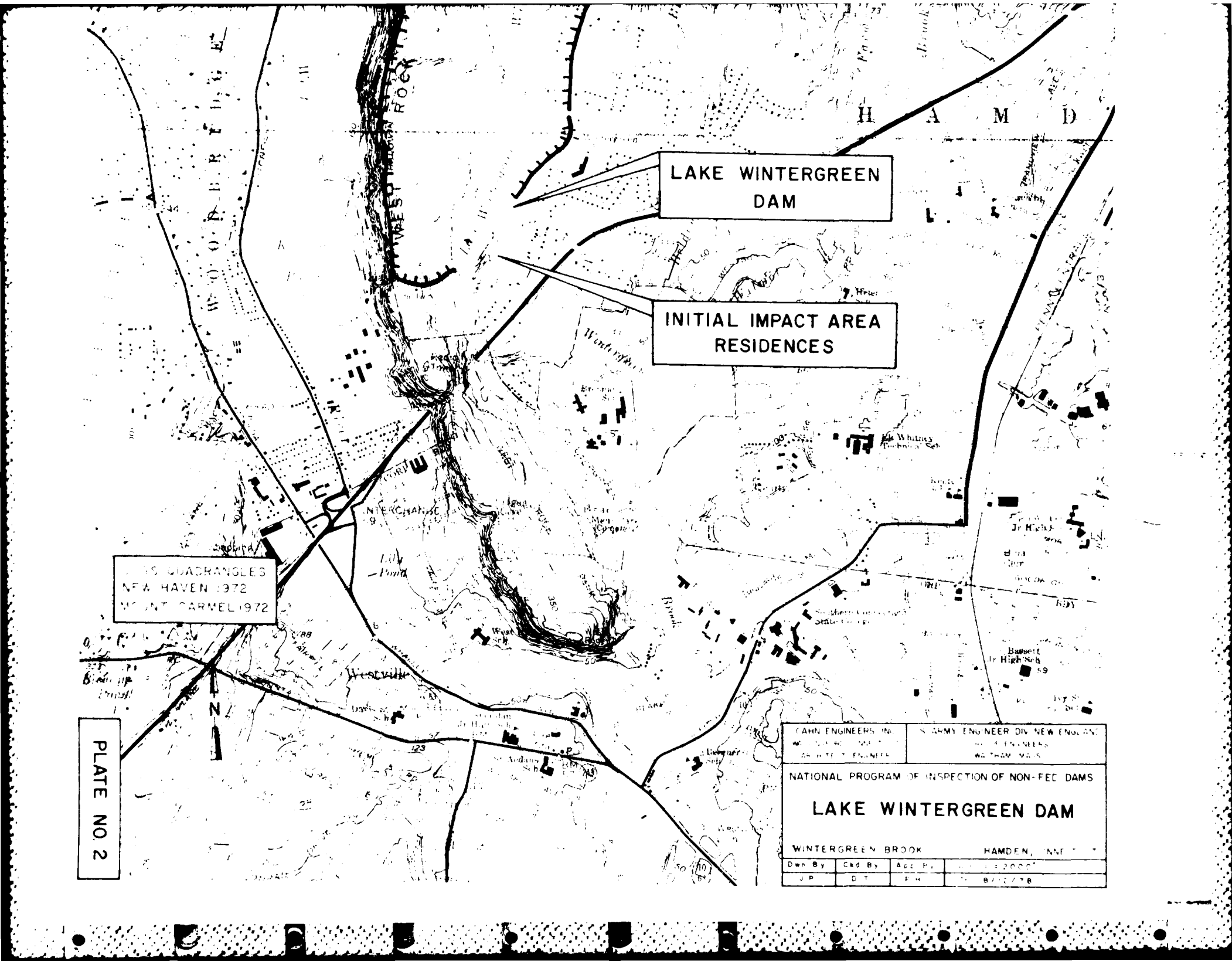
Connecticut
SCALE OF MILE
LONG ISLAND
NEW HAVEN
BRIDGEPORT
STRATFORD
MILFORD
Derby
Shelton
Ansonia
Woodbridge
Hamden
North Haven
East Haven
West Haven
Orange
Trumbull
Long Hill
Huntington
Monroe
Newtown
Seymour
Oxford
Westport
Fairfield
Easton
Redding
Ridgefield
Weston
Wilton
Norwalk
Stamford
SHERWOOD ISLAND STATE PARK
SILVER SANDS STATE PARK
INDIAN WELL STATE PARK
PAUGUSSETT STATE FOREST
QUINNIPIAC RIVER STATE PARK
Plate


LAKE WINTERGREEN
DAM
INITIAL IMPACT AREA
RESIDENCES
H A M D
W O O D B R I D G E
WEST ROCK
INTERCHANGE
Westville
Bassett
Jr High Sch
N
USGS QUADRANGLES
NEW HAVEN 1972
MOUNT CARMEL 1972
PLATE NO. 2
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS
LAKE WINTERGREEN DAM
WINTERGREEN BROOK
HAMDEN, CONN.
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Chd By
Apd By
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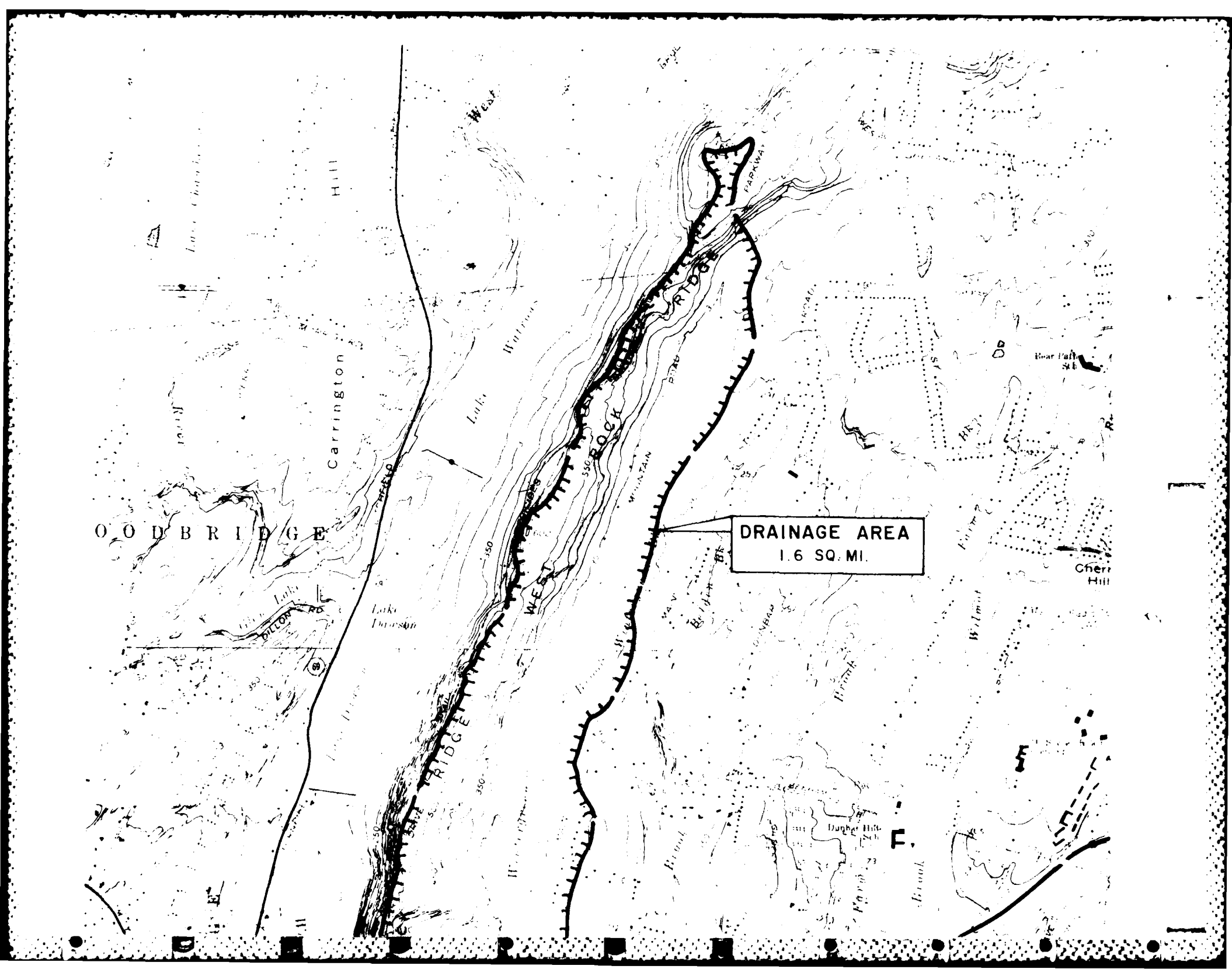
8/27/78


DRAINAGE AREA
1.6 SQ. MI.
WEST ROCK RIDGE
ODDBRIDGE
Carrington
Hill
Lake Dawson
DILLON RD
PARKWAY
ROCK MOUNTAIN ROAD
Bear Path
Cherr Hill
Wilmot
Dunbar Hill
F.

PHASE I INSPECTION REPORT

LAKE WINTERGREEN DAM

SECTION I

PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Cahn Engineers, Inc. has been retained by the New England Division to inspect and report on selected dams in the southwestern portion of the State of Connecticut. Authorization and notice to proceed were issued to Cahn Engineers, Inc. under a letter of April 26, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0310 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection Program - The purposes of the program are to:

(1) Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interests.

(2) Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.

(3) To update, verify and complete the National Inventory of Dams.

c. Scope of Inspection Program - The scope of this Phase I inspection report includes:

(1) Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.

(2) A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

(3) Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

(4) An assessment of the condition of the facility and corrective measures required.

It should be noted that the report does not pass judgement on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features on the dam which need corrective action and/or further study.

1.2 Description of Project

a. Description of Dam and Appurtenances - The dam consists of two sections. The portion of the dam from the spillway 185 feet to the left is an earthen embankment on the upstream side of a rubble masonry retaining wall. The remaining portion of the dam to the left of the retaining wall is an earthen embankment. According to the existing information, a rubble masonry corewall exists from the spillway 260 feet to the left. The corewall is 3.5 feet wide at the top and has both upstream and downstream faces battered approximately 1 1/4 in 12. The dam, constructed adjacent to a natural rock ridge on the right, is approximately 900± feet in length and rises approximately 31± feet above the elevation of the original streambed. The retaining wall reportedly varies from 6 feet wide at the top to 17 feet wide, at the bottom. The spillway is reported as a 50 foot wide concrete weir with concrete wingwalls. The inoperative low level outlet is a 12 inch cast iron pipe exiting from the face of the masonry retaining wall on the downstream side of the dam at elevation 221.6.

b. Location - The dam is located on Wintergreen Brook in a residential area in the town of Hamden, County of New Haven, State of Connecticut. The dam is shown on the New Haven U.S.G.S. Quadrangle Map as having coordinates of longitude W72° 58' 04" and latitude N41° 21' 13".

c. Size Classification - SMALL The dam has approximate storage of 540 acre feet at the top of dam, elevation 246.8, which is approximatley 31 feet above the

elevation of the old streambed. According to the Recommended Guidelines, a dam with storage of less than 1000 acre feet is considered small.

d. Hazard Classification - HIGH (Category I) Residential developments, some of which are visible in the overview photo, and the Wilbur Cross Parkway located downstream of the dam provide potential for severe loss of life should the dam breach.

e. Ownership - The New Haven Water Company
Sargent Drive
New Haven, Connecticut 06506
Mr. Joseph Jiskra
Mr. Jack Reynolds
Phone (203) 624-6671

f. Purpose of Dam - Public Water Supply

g. Design and Construction History - The following information is believed to be accurate based on the plans and correspondence available and included in the Appendix. The dam was constructed in 1863. The engineer for the original construction was not noted in the available data.

The New Haven Water Company acquired the dam from the Fairhaven Water Company in 1876. In 1944, the original natural rock spillway was widened from 25 feet to approximately 50 feet. The new spillway and wingwalls were both constructed of concrete as engineered by Clarence M. Blair, Inc.

h. Normal Operational Procedures - Daily lake level readings are taken in the vicinity of the inflow to the reservoir. Guards patrol the dam on an irregular basis.

1.3 Pertinent Data

a. Drainage Areas - 1.6 square miles (1024 acres). Rolling, wooded terrain.

b. Discharge at Dam Site - Maximum known flood -During the August and October 1955 floods, the maximum water over the spillway was one foot, which constituted a rise of approximately four feet from the previous reading. Total spillway capacity at elevation 246.8 (top of dam) 850 cfs.

c. Elevation - (Ft. above MSL, USGS Datum)

Top of Dam:	246.8 typ.(246.3 min.)
Spillway Crest:	242.8
Streambed:	215±
High Level Intake:	Not Known
Low Level Intake:	Not Known
Outlet Pipe:	221.6

d. Reservoir - Length of Normal Pool: 1,500 ft.

Length of Maximum Pool: 1,500+ ft.

e. Storage - At Elevation 242.8 307 acre ft.
At Elevation 246.8 540 acre ft.

f. Reservoir Surface -

At Elevation 242.8 43.5 acres
At Elevation 246.8 90 acres

g. Dam - Type: Earth fill, masonry core, and natural rock formations with rubble masonry retaining wall on downstream face.

Length: 900± feet

Height: 31± ft. above original streambed

Top Width: 15± feet typical, 60± maximum

Side Slope: Upstream 2H to 1V (Max.)

Downstream 2H to 1V

Core: Rubble masonry core 260' long

Cutoff: Rubble masonry core founded on rock.

h. Diversion and Regulatory Tunnel - Not Applicable.

i. Spillway

Type:	Broad crested concrete weir.
Length of Weir:	50'
Crest Elevation:	242.8
Upstream Channel:	10H to 1V
Downstream Channel:	1.5H to 1V (Max.) approximately

j. Regulatory Outlets

High Level Intake:	Manually operated 16" line to chlorination, station. located 900± right of spillway
Low Level Intake:	Size 12' dia. cast iron, non-functioning manually operated, located in downstream face at elevation 221.6.

SECTION 2: ENGINEERING DATA

2.1 Design

a. Available Data - The available data consists of drawings, correspondence, and records by the State of Connecticut, the New Haven Water Company, Joseph W. Cone and others.

b. Design Features - The maps, drawings and reports included in the Appendix show the design features of the dam as stated previously herein.

c. Design Data - There were no engineering values, assumptions, test results or calculations available for the original construction or the later spillway reconstruction.

2.2 Construction

a. Available Data - There were no construction drawings available for the original construction of the dam. Much of the data used to construct the plan entitled "Dam -Plan, Profiles and Sections" in Appendix B, page B-35, was retrieved from a rough field survey performed by Cahn Engineers during the course of this investigation.

b. Construction Considerations - No information was available.

2.3 Operation

Water level readings are taken daily, although not in the area of the dam. No formal operation and maintenance procedures are in effect. Someone visits the chlorination station at least once a week, and a guard employed by the owner patrols the dam on an irregular basis.

2.4 Evaluation

a. Availability - Existing data was provided by the owner and the State of Connecticut. The owner made operations available for visual inspection.

b. Adequacy - The engineering data available was not sufficient to perform any in-depth analyses of the dam. Therefore, the final assessment of this investigation must be based primarily on visual inspection, performance history and hydraulic/hydrologic assumptions.

c. Validity - A comparison of record data and visual observations reveals no observable significant discrepancies in the record data.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General - In general, the dam appears to be in fair condition, however, there are some areas in need of maintenance.

b. Dam - The dam consists of an earth dam section on the left and a masonry retaining wall with an apparent upstream earth embankment on the right adjacent to the spillway.

Upstream - The water level in the reservoir was slightly over the spillway, and thus only the upper part of the slope could be inspected. The riprap protection, in general, covers the slope only below the spillway crest level. Some erosion of the slope above the riprap is evident resulting in localized areas with very steep soil faces. There is some grass and bushes growing on the upstream slope.

Crest - The crest of the dam is grass-covered and does not show evidence of cracking or erosion.

There is some minor sloughing of the crest next to the upstream slope in an area near the spillway, probably as the result of the erosion noted in the upper part of the upstream slope. In this area the crest is about 60 ft. wide.

Downstream Slope

Earth Fill Section - The downstream slope is covered with grass and bushes making it impossible to observe sloughing or erosion. There are several seeps at a level slightly higher than the road, and the water flow collects in the tracks made by road traffic. Locations where seeps occurred were identified in the following areas:

a. In an area ranging from 750 to 800 ft. to the left of the left wall of the spillway, there are several seeps near the road.

b. At distances of 500 to 600 ft. to the left of the spillway's left edge, there are several seeps at about mid-height of the slope over the road. The water can be heard running under the vegetation.

c. Another area of seeps is located at distances of 250 ft. to 300 ft. to the left of the spillway and at the toe of the slope.

The flow from these seeps collects along the road and flows toward the topographical low near the spillway channel.

There is an area further to the right from the three areas of seeps identified above, where a crushed stone toe drain with a perforated pipe was installed.

No evidence was observed of suspended solids in any of the seeps described above. However, the presence of solids in the water would be difficult to detect for most of the seeps because of the heavy vegetation.

Another seep was identified downstream of the road and below the stone toe drain shown.

Masonry Wall Section - The wall is very irregular and thus visual inspection would not detect any misalignment or movements of the wall. There are some bushes growing on the wall which can accelerate deterioration of the wall. There are several seeps through the wall, one of which comes from under the inoperative 12" low level outlet. The water is clear and does not produce significant staining of the wall.

c. Appurtenant Structures - The spillway and its downstream channel are excavated in bedrock. The concrete weir and wingwalls have deteriorated and in general appear to be only in fair condition. Six metal rods protrude approximately 4 feet up from the center of the concrete spillway crest. The channel is very steep (maximum 1.5H to 1V inclination), and has a very irregular bottom. There are no obstructions to the flow of water in the channel. The high level intake approximately 900+ feet to the right of the dam is a 16 inch water supply line to the downstream chlorination station. The low level intake is a 12 inch cast iron pipe exiting from the masonry retaining wall at an elevation of approximately 221.6.

d. Reservoir Area - The area immediately surrounding the reservoir is forested and undeveloped with the exception of the extreme northeastern portion of the lake, which is near a small number of single family residences above the reservoir. No erosion or sedimentation problems are known to exist.

3.2 Evaluation

The visual inspection was sufficient to determine the dam to be in fair condition based upon external appearances. Significant runoff from seeps exiting from the downstream face of the dam was observed along the toe of the dam; however, it was not possible to determine the locations or magnitudes of the individual seeps due to the heavy ground cover growth. It was not possible to make an evaluation of the stability of the dam based solely on visual observations, due primarily to the lack of knowledge on the cross section of the dam, and the irregularity of the retaining wall face, which rendered it impossible to detect movement or misalignment of the wall. It was noted that the 12 inch cast iron low level intake is inoperative.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Regulating Procedure

The low level outlet is not operational, therefore only the 16 inch supply line is available to regulate the water level. However, the reservoir is not in use as a water supply and thus the gatehouse is visited only once a week. The water supply is in reserve status.

4.2 Maintenance of Dam

The brush and vegetation on the dam and on the downstream slope of the dam is cleared once a year. No other maintenance was evident at the time of our field inspection. The concrete at the spillway is deteriorated. Brush was growing through the face of the masonry retaining wall.

4.3 Maintenance of Operating Facilities

The low level outlet is inoperative. No regular maintenance of operating facilities was evident at the time of our field investigation.

4.4 Description of Any Warning System in Effect

No formal warning system is in effect.

4.5 Evaluation

A formal program of operation and maintenance procedures should be instituted, to include complete, accurate documentation to provide records for future reference. Specific areas requiring maintenance include 1) the inoperative low level outlet, 2) the heavy vegetation on the downstream slope and brush growing from the retaining wall, and 3) spalling of the concrete spillway.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data - No computations could be found for the original 1863 dam construction or the 1944 spillway reconstruction.

b. Experience Data - Water generally flows over the spillway from late fall to early summer. The maximum recorded water level over the spillway during the August and October 1955 floods was 12 inches on October 16, 1955.

c. Visual Observations - The spillway could become blocked due to debris becoming caught on the six metal rods protruding up from the spillway crest.

d. Overtopping Potential - The Test Flood for this high hazard small size dam is equal to the Probable Maximum Flood (PMF) of 3,000 cfs.

Based upon our hydraulics computations, the spillway capacity is 850 cubic feet per second (Appendix D-10). Based upon "Preliminary Guidance for Estimating Maximum Probably Discharges" dated March 1978, peak inflow to the reservoir is 3,500 cubic feet per second (Appendix D-8); peak outflow (Test Flood) is 3,000 cubic feet per second with the dam overtopped 0.8 feet (Appendix D-12).

Since the watershed area (1.6 square miles) of Lake Wintergreen is smaller than two square miles, it may be appropriate to consider higher intensity short duration storms. One such calculation is shown in Appendix D.

e. Spillway Adequacy - The spillway will pass only 28 percent of the Test Flood at elevation 246.8 (top of dam elevation).

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations - Visual observations do not indicate any immediate stability problems, however, due to the irregularity of the face of the retaining wall, movement on misalignment of the wall was impossible to discuss. There are some observed features which could present a problem in the future.

b. Design and Construction Data - The design and construction data is insufficient to analyze the stability of the dam. There is no information concerning the cross-section of the dam, the materials used to construct it, or the foundation soil or bedrock.

c. Operating Records - The dam was built in 1863 and the spillway modified in 1944. The available records are limited and do not contain evidence of instability problems during the operational history of the dam.

d. Post Construction Changes - The spillway was modified in 1944, and a toe drain was installed near the base of the downstream earthen embankment at some later date.

e. Seismic Stability - This dam is in Seismic Zone 1 and hence does not have to be evaluated for seismic stability, according to the Recommended Guidelines.

SECTION 7: ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - A visual inspection and a review of a limited amount of available design and construction data did not disclose any findings indicating an unstable condition in the immediate future. There are, however, some findings which require remedial action and close monitoring to ensure the future stability of the dam.

Based upon our hydraulics computations, the spillway capacity is 850 cubic feet per second, which is equivalent to approximately 28 percent of the Test Flood. Based upon "Preliminary Guidance for Estimating Maximum Probable Discharges" dated March 1978, peak inflow to the reservoir is 3,500 cubic feet per second; peak outflow is 3,000 cubic feet per second with the dam overtopped 0.8 feet.

Utilizing the April 1978 "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs", the peak failure outflow from the dam would be 80,400 cubic feet per second. A breach of the dam would result in a 20 foot wave which would cause severe loss of life and damage to property immediately downstream of the dam.

b. Adequacy of Information - The information available is not sufficient to analyze the stability of the dam. An assessment of the dam must thus be based solely on a visual inspection, which cannot disclose all potential problems the dam may develop in the future.

c. Urgency - The recommendations and remedial measures presented in Sections 7.2 and 7.3 should be implemented within the time frame specified in each section.

d. Need for Additional Information - There is a need for additional information as described in Section 7.2.

7.2 Recommendations

The recommendations presented in this section should be instituted within 6 months of the owner's receipt of this Phase I Inspection Report.

1. Based upon the rough computation in Appendix D, the dam spillway capacity will be exceeded by the test flood. More sophisticated flood routing should be undertaken by hydrologist/hydraulics engineers to refine the test flood figures. A study should be undertaken and recommendations made to increase the spillway capacity to an acceptable level based upon the refined test flood figures. An alternative to this could be raising the dam crest to accomodate increased storage.

2. The low level intake should be made operable so the reservoir water can be lowered in cases of emergency or for maintenance.

3. The numerous seeps along the downstream slope of the earth embankment section should be monitored monthly (complete with photographic records) by a qualified engineer for turbidity of the water, for volume of flow, and for development of new seeps. With the present vegetation cover of the slope, such monitoring would not be effective, thus monitoring of the seeps requires that the downstream slope of the earth embankment be cleared of bushes and small trees, and planted with grass to control erosion. Turbidity of the water, appearance of new seeps or substantial changes in flow not related to reservoir water levels should be considered as possible indications of an unsafe condition. Should examination of the seepage indicate a possibly unsafe condition, we recommend that an investigation be conducted by an engineer qualified in dam inspection to determine the seriousness of the seepage problem and recommend seepage control measures such as toe drains should it become necessary.

7.3 Remedial Measures

a. Alternatives - This study has identified no practical alternatives to the above recommendations.

b. Operation and Maintenance Procedures - The following measures should be undertaken within 6 months of the owner's receipt of this report and continued on a regular basis.

1. The bushes growing in the downstream face of the stone wall should be removed and measures taken to discourage future growth, thus reducing further deterioration of the masonry.

2. A formal program of operation and maintenance procedures should be instituted, and fully documented to provide accurate records for future reference.

3. During the course of this study, it was brought to our attention that the New Haven Water Company instituted a yearly program for inspection of all their dams, including Lake Wintergreen Dam, by a consultant competent in the field of dam inspection. This program, in effect for two years, is commendable and should be continued in the future.

4. The six metal rods protruding up from the concrete spillway crest should be removed to prevent blockage of the spillway by debris during high water levels.

5. Required remedial measures should be carried out for the repair of the concrete spillway and abutment walls which have deteriorated due to concrete spalling.

6. Round the clock surveillance should be provided by the owner during periods of unusually heavy precipitation. The owner should develop a formal warning system with local officials for alerting downstream residents in case of emergency.

APPENDIX

SECTION A: VISUAL OBSERVATIONS

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Lake Wintergreen Dam **DATE:** June 6, 1978

TIME: 8:30 a.m.

WEATHER: Clear, 70°

W.S. ELEV. 242.8 **U.S.** — **DN.S**

PARTY:	INITIALS:	DISCIPLINE:
1. Mike Horton	MH	Structural
2. Gonzalo Castro	GC	Geotechnical
3. Peter Heynen	PH	Party Chief
4.		
5.		
6.		

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Earth Dam Embankment with Masonry Retaining Wall	GC/MH/PH	
2.	Spillway-Approach, Channel, Weir, Discharge Channel	GC/MH	
3.	Outlet Works-Inlet Channel and Inlet Structure	MH	
4.	Outlet Works - Gate Shafts	PH	
5.	Reservoir	PH	
6.	Operations and Maintenance	PH	
7.	Safety and Performance Instrumentation	PH	
8.			
9.			
10.			
11.			
12.			

PERIODIC INSPECTION CHECK LIST

PROJECT Lake Wintergreen Dam **DATE** June 6, 1978

PROJECT FEATURE Earth Dam Embankment with Partial Masonry D.S. Wall

AREA EVALUATED	BY	CONDITION
Crest Elevation		
Current Pool Elevation	PH	Four (4) feet ± top of dam.
Maximum Impoundment to Date	PH	Not known.
Surface Cracks	GC	None observed.
Pavement Condition	GC	No pavement.
Movement or Settlement of Crest	GC	Some apparent movement near U.S. slope at about 60 ft. right of spillway.
Lateral Movement	GC	Same as above.
Vertical Alignment	GC	Appears in good condition.
Horizontal Alignment	GC	Appears in good condition.
Condition at Abutment and at Masonry Structures	GC/ MH	Good.
Indications of Movement of Structural Items on Slopes	MH	None.
Trespassing of Slopes	GC	Minor footpaths.
Sloughing or Erosion of Slopes or Abutments	GC	None except as noted above.
Rock Slope Protection-Riprap Failures	GC	Riprap protection observed under water, exposed portion of U.S. slope unprotected.
Unusual Movement or Cracking at or near Toe	GC	None observed.
Unusual Embankment or Downstream Seepage	GC/ PH	Several seeps near D.S. toe, and through masonry D.S. wall. Seepage appears clear.
Piping or Boils	GC	None observed.
Foundation Drainage Features	GC	None apparent.
Toe Drains	GC	None apparent except for a short section with toe drain.

PERIODIC INSPECTION CHECK LIST

PROJECT Lake Wintergreen DATE [illegible]

PROJECT FEATURE Earth Dam - Embankment with Partial Masonry D.S. Wall

AREA EVALUATED	BY	CONDITION
Vegetation	GC	Grass, small bushes on D.S. slope above road. Heavily wooded below.
Instrumentation Systems	GC	None known.

PERIODIC INSPECTION CHECK LIST

PROJECT Lake Wintergreen Dam **DATE** June 6, 1978

PROJECT FEATURE Spillway-Approach, Channel, Weir, Discharge Channel

AREA EVALUATED	BY	CONDITION
a. Approach Channel		
General Condition		
Loose Rock Overhanging Channel		
Trees Overhanging Channel		
Floor of Approach Channel		
b. Weir and Training or Sidewalls		
General Condition of Concrete	MH	Poor.
Rust or Staining	MH	Yes.
Spalling	MH	No.
Any Visible Reinforcing	MH	None.
Any Seepage or Efflorescence		
Drain Holes	GC	None observed.
c. Discharge Channel		
General Condition	GC/MH	Good. Natural rock channel.
Loose Rock Overhanging Channel	GC	Minor.
Trees Overhanging Channel	GC/MH	None.
Floor of Channel	GC	Bedrock.
Other Obstructions	GC	None.

PERIODIC INSPECTION CHECK LIST

PROJECT Lake Wintergreen Dam **DATE** June 6, 1978

PROJECT FEATURE Outlet Works-Inlet Channel & Inlet Structure

AREA EVALUATED	BY	CONDITION
a. Approach Channel		
Slope Conditions		
Bottom Conditions		
Rock Slides or Falls		
Log Boom		
Debris		
Condition of Concrete Lining		
Drains or Weep Holes		
b. Intake Structure	MH	Abandoned low level outlet (blowoff).
Condition of Concrete		
Stop Logs and Slots		

PERIODIC INSPECTION CHECK LIST

PROJECT Lake Wintergreen Dam **DATE** June 6, 1978

PROJECT FEATURE Outlet Works-Control Tower, Operating House, Gate Shafts

AREA EVALUATED	BY	CONDITION
a. Concrete and Structural		
General Condition		
Condition of Joints		
Spalling		
Visible Reinforcing		
Rusting or Staining of Concrete		
Any Seepage or Efflorescence	PH	Seepage from abandoned 12 inch outlet.
Joint Alignment		
Unusual Seepage or Leaks in Gate Chamber		
Cracks		
Rusting or Corrosion of Steel	PH	Yes, iron structure.
b. Mechanical and Electrical		
Air Vents		
Float Wells		
Crane Hoist		
Elevator		
Hydraulic System		
Service Gates		
Emergency Gates		
Lighting Protection System		
Emergency Power System		

PERIODIC INSPECTION CHECK LIST

Page

PROJECT Lake Wintergreen Dam DATE June 6

PROJECT FEATURE Reservoir

AREA EVALUATED	BY	CONDITION
Shoreline	PH	Wooded, earth or rock exposed
Sedimentation	PH	None observed.
Potential Upstream Hazard Areas	PH	None observed.
Watershed Alteration-Runoff Potential		

PERIODIC INSPECTION CHECK LIST

PROJECT Lake Wintergreen Dam DATE June [illegible]

PROJECT FEATURE Operations and Maintenance

AREA EVALUATED	BY	CONDITION
a. Reservoir Regulation Plan		
Normal Conditions	PH	Someone visits gate house once a [illegible]. Gate house not adjacent to dam.
Emergency Plans	PH	None known.
Warning System	PH	None known.
b. Maintenance (Type) (Regularity)		
Dam	PH	Clearing and grubbing once a year.
Spillway	PH	None evident. Concrete deteriorated.
Outlet Works	PH	Low level outlet inoperative.

PERIODIC INSPECTION CHECK LIST

PROJECT Lake Winterqreen Dam **DATE** June 29, 1979

PROJECT FEATURE Safety and Performance Instrumentation

AREA EVALUATED	BY	CONDITION
Headwater and Tailwater Gages	PH	None known.
Horizontal and Vertical Alignment Instrumentation (Concrete Structures)	PH	None.
Horizontal and Vertical Movement, Consolidation, and Pore-Water Pressure Instrumentation (Embankment Structures)	PH	None.
Uplift Instrumentation	PH	None.
Drainage System Instrumentation	PH	Lake levels recorded at inflow to reservoir, not at dam.
Seismic Instrumentation	PH	None.

APPENDIX
SECTION B: EXISTING DATA

SPECIAL NOTE

SECTION B

AVAILABILITY OF DATA

The correspondence listed in the Summary of Contents and the plans listed in the Table of Contents, Appendix Section B, in the master copy of this report, which is on file at the office of the Army Corps of Engineers, New England Division, in Waltham, Massachusetts.

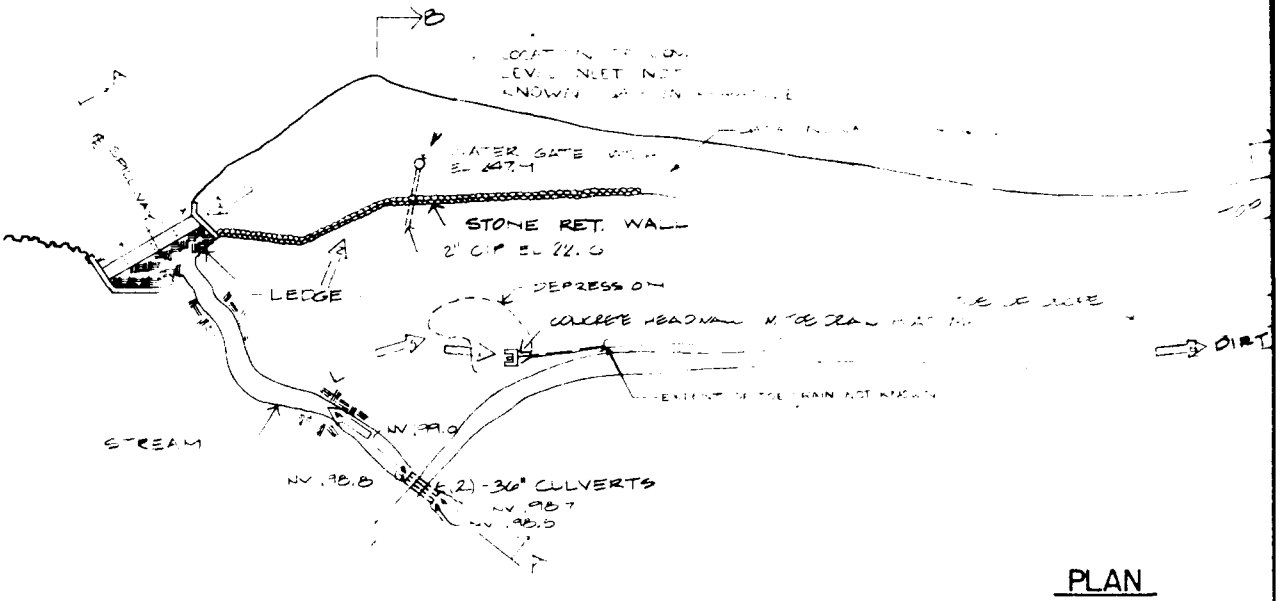
SECTION B: EXISTING DATA

SUMMARY OF CONTENTS

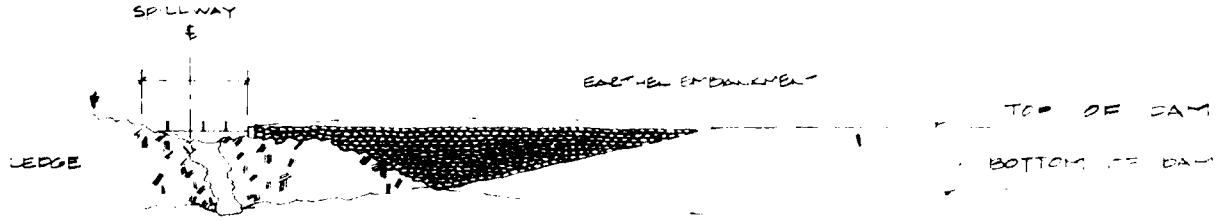
DATE	TO	FROM	SUBJECT	PAGE
Apr. 29, 1963	A.L. Corbin, Jr.	Joseph A. Novaro, Chief Engineer, New Haven Water Company[2]	West River Watershed	B-1
July 36, 1963	Files	Water Resources Commission[1]	Dam Inventory Data and Property Map	B-4
Apr. 30, 1965	Joseph W. Cone	New Haven Water Company[1]	Transmittal of (and including) lake level and rain guage records.	B-7
August 1974	Files	New Haven Water Company[2]	Wintergreen Dam Data Sheets and Photographs	B-14

[1]Obtained from the State of Connecticut Water Resources Commission

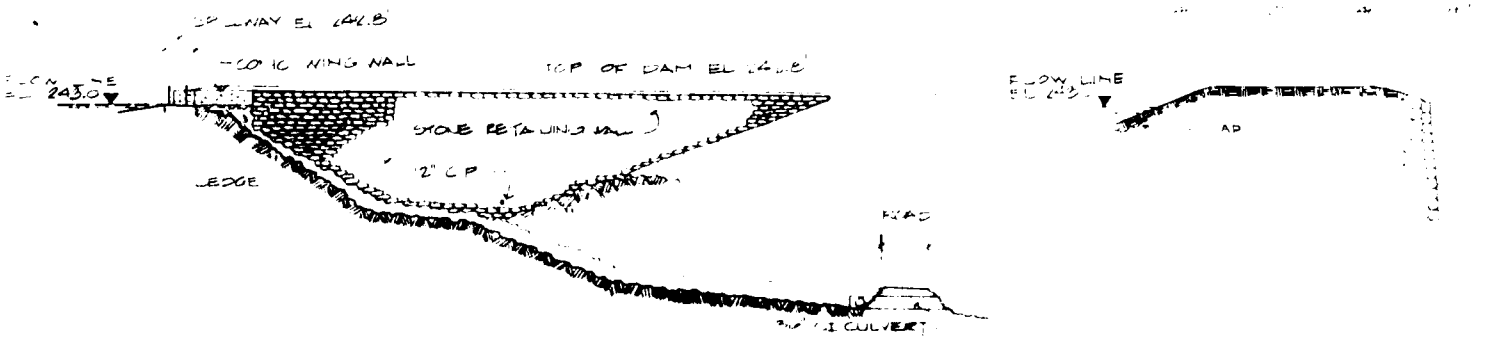
[2]Obtained from the New Haven Water Company



PLAN

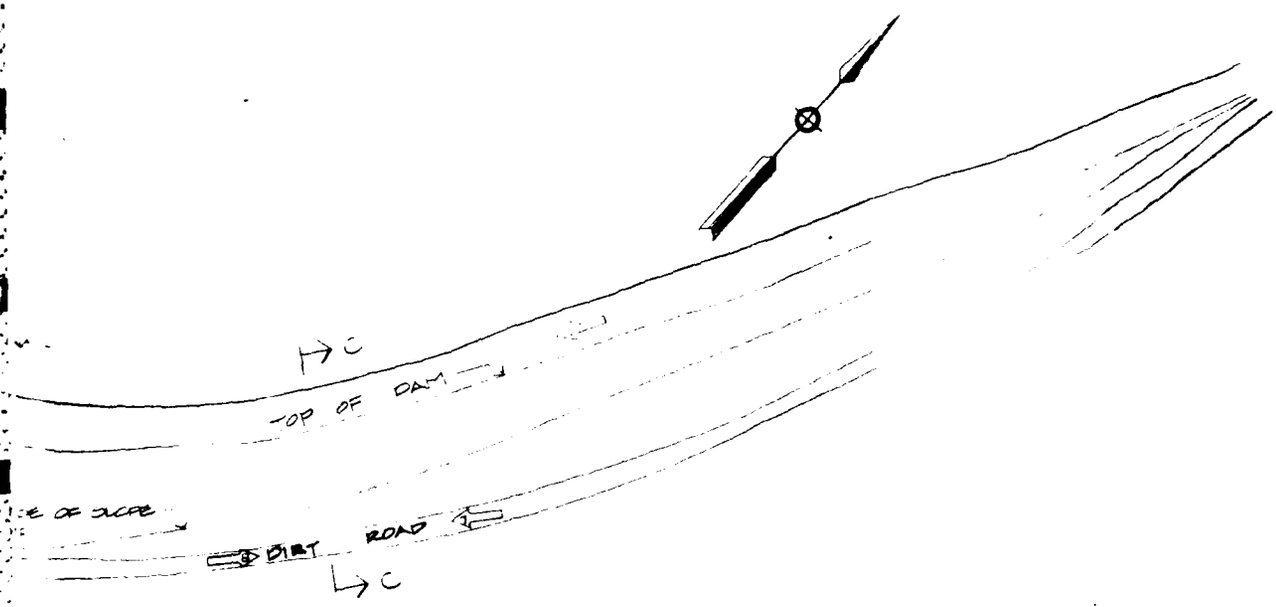


PROFILE



SECTION A-A

SECTION B-B



PLAN

0 40 80

NOTE: ALL INFORMATION SHOWN HEREIN HAS BEEN COMPILED FROM EXISTING RECORDS DATA AND VISUAL OBSERVATIONS

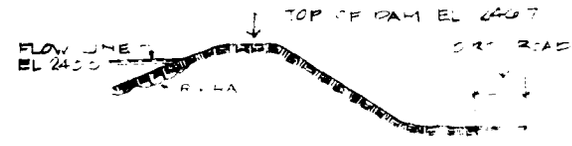
PHOTO NUMBER AND DIRECTION

TOP OF DAM EL 440.5

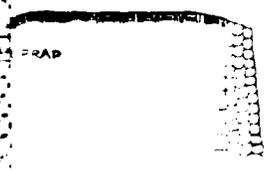
BOTTOM OF DAM

PROFILE

0 40 80



SECTION C-C



SECTION B-B

0 20 40

GAHN ENGINEERS, INC.		U.S. ARMY ENGINEER DIVISION, NEW ENGLAND	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
LAKE WINTERGREEN DAM			
WINTERGREEN BROOK		HAMDEN, CONNECTICUT	
DWN BY: M	CKD BY: CEG	APP BY: PMH	DATE: 6/6/78
PAGE B 28			

APPENDIX

SECTION C: DETAIL PHOTOGRAPHS

PHOTO NO.1 - General view of crest of dam taken from left end.

PHOTO NO.2 - General view of masonry retaining wall. Note brush growing from face of wall and 12 inch outlet exiting from lower face.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	LAKE WINTERGREEN DAM WINTERGREEN BROOK HAMDEN, CONNECTICUT
CAHN ENGINEERS INC. WALLINGFORD, CONN. ARCHITECT—— ENGINEER	INSPECTION OF NON-FED. DAMS	CE # 27 531 GE DATE 6/6/78 PAGE C-1

PHOTO NO.3 - Spillway crest and right abutment.

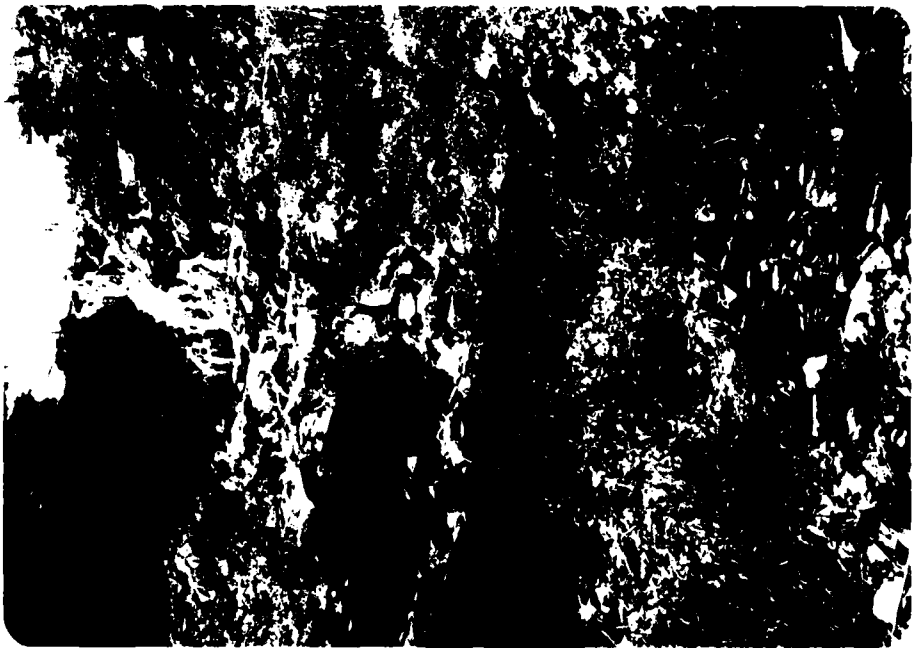


PHOTO NO.4 - Natural rock spillway channel. Note metal rods indicating spillway location.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	LAKE WINTERGREEN DAM WINTERGREEN BROOK
CAHN ENGINEERS INC. WALLINGFORD, CONN. ARCHITECT—— ENGINEER	INSPECTION OF NON-FED. DAMS	HAMDEN, CONNECTICUT CE # 27 531 GE DATE 6/6/78 PAGE C-2

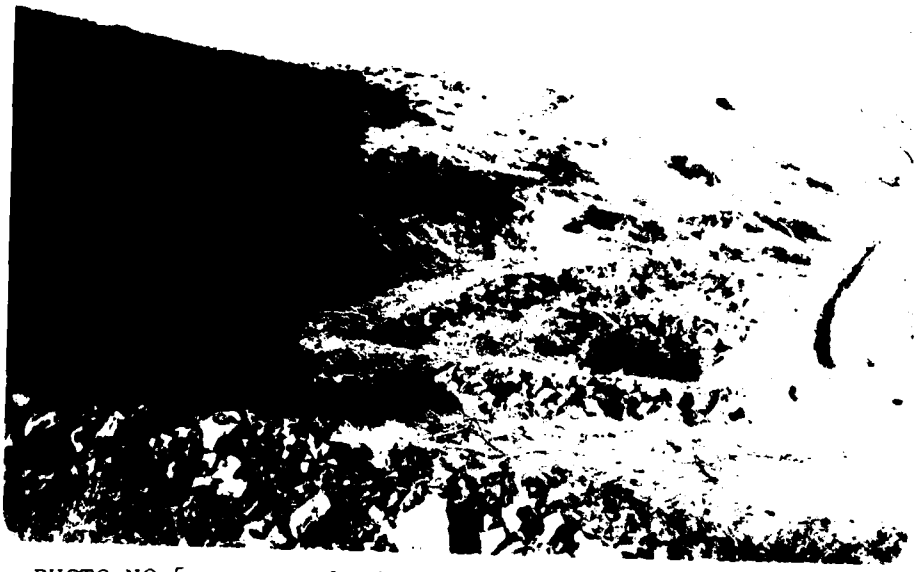


PHOTO NO.5 - General view of earthen embankment to left of masonry wall. Note toe drain outlet and stone in lower right corner of picture. (Below)

PHOTO NO.6 - Close up view of toe drain outlet pipe and structure.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	LAKE WINTERGREEN DAM WINTERGREEN BROOK HAMDEN, CONNECTICUT
CAHN ENGINEERS INC. WALLINGFORD, CONN. ARCHITECT—— ENGINEER	INSPECTION OF NON-FED. DAMS	CE # 27 531 GE DATE 6/6/78 PAGE C-3

PHOTO NO.7 - General view of seepage flowing in dirt road at left end of dam.

PHOTO NO.8 - Closeup of seepage flowing in dirt road.

APPENDIX

SECTION D: HYDRAULIC/HYDROLOGIC COMPUTATIONS

PRELIMINARY GUIDANCE

FOR ESTIMATING

MAXIMUM PROBABLE DISCHARGES

IN

PHASE I DAM SAFETY

INVESTIGATIONS

New England Division
Corps of Engineers

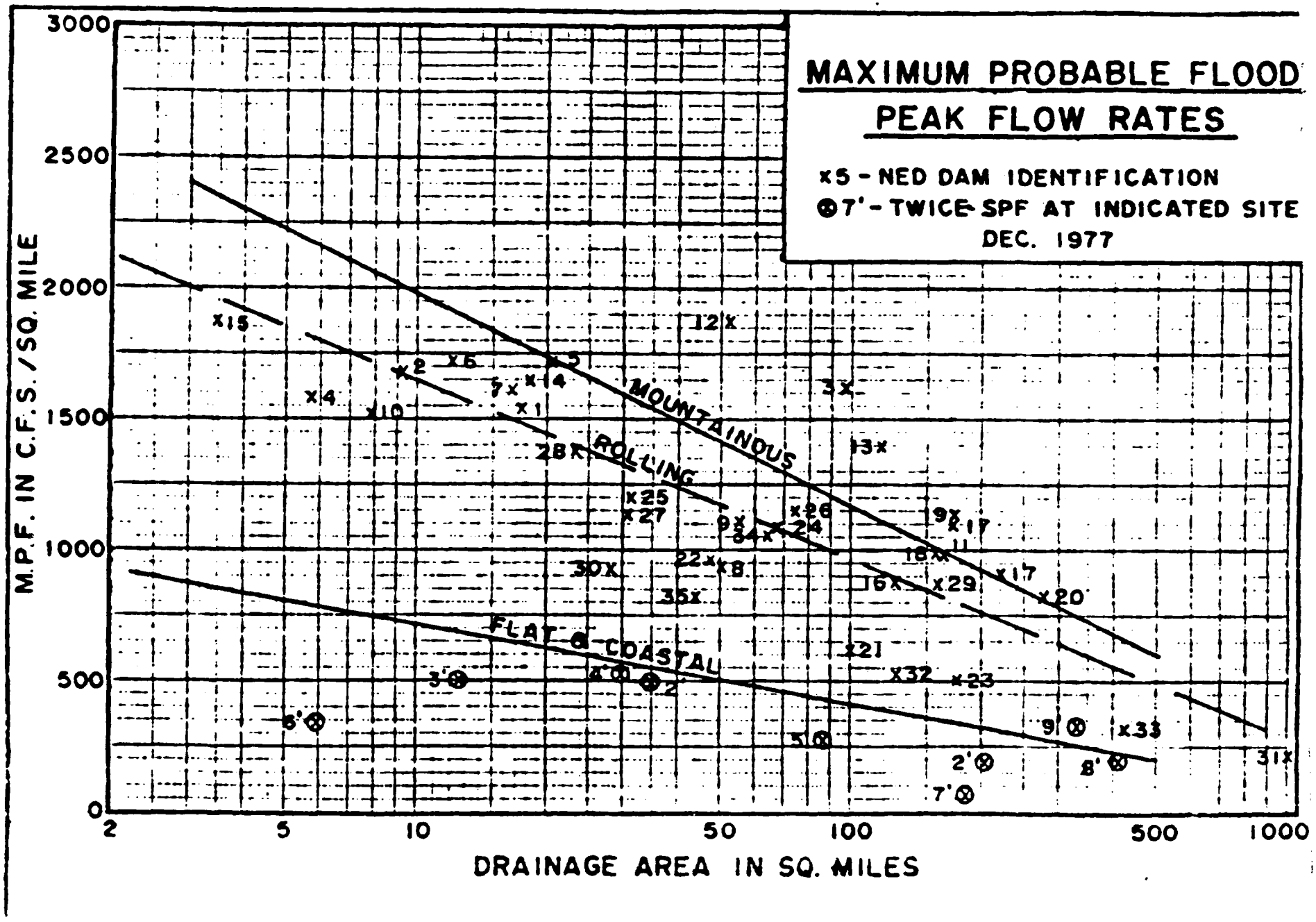
March 1978

MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

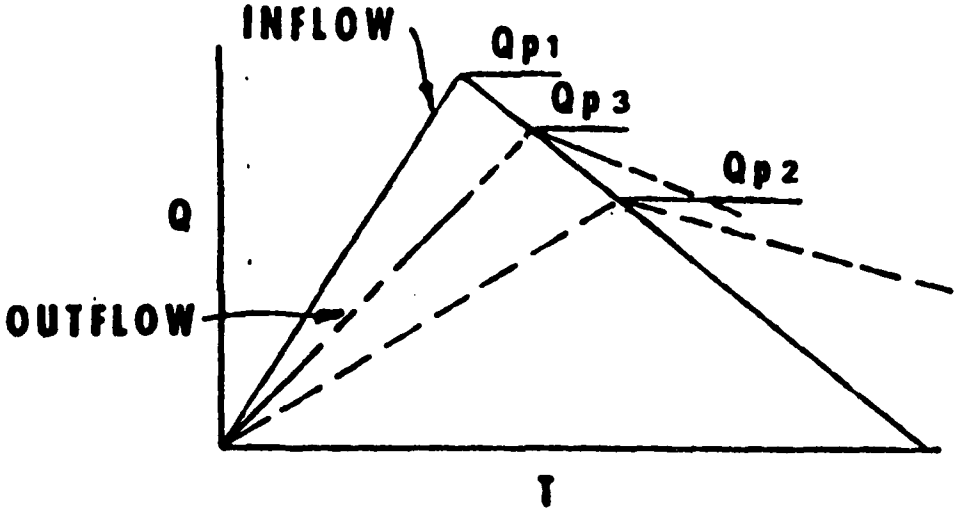
	Project	Q (cfs)	D.A. (sq. mi.)	MPF cfs/sq. mi.
1.	Hall Meadow Brook	26,600	17.2	1,546
2.	East Branch	15,500	9.25	1,675
3.	Thomaston	158,000	97.2	1,625
4.	Northfield Brook	9,000	5.7	1,580
5.	Black Rock	35,000	20.4	1,715
6.	Hancock Brook	20,700	12.0	1,725
7.	Hop Brook	26,400	16.4	1,610
8.	Tully	47,000	50.0	940
9.	Barre Falls	61,000	55.0	1,109
10.	Conant Brook	11,900	7.8	1,525
11.	Knightville	160,000	162.0	987
12.	Littleville	98,000	52.3	1,870
13.	Colebrook River	165,000	118.0	1,400
14.	Mad River	30,000	18.2	1,650
15.	Sucker Brook	6,500	3.43	1,895
16.	Union Village	110,000	126.0	873
17.	North Hartland	199,000	220.0	904
18.	North Springfield	157,000	158.0	994
19.	Ball Mountain	190,000	172.0	1,105
20.	Townshend	228,000	106.0(278 total)	820
21.	Surry Mountain	63,000	100.0	630
22.	Otter Brook	45,000	47.0	957
23.	Birch Hill	88,500	175.0	505
24.	East Brimfield	73,900	67.5	1,095
25.	Westville	38,400	99.5(32 net)	1,200
26.	West Thompson	85,000	173.5(74 net)	1,150
27.	Hodges Village	35,600	31.1	1,145
28.	Buffumville	36,500	26.5	1,377
29.	Mansfield Hollow	125,000	159.0	786
30.	West Hill	26,000	28.0	928
31.	Franklin Falls	210,000	1000.0	210
32.	Blackwater	66,500	128.0	520
33.	Hopkinton	135,000	426.0	316
34.	Everett	68,000	64.0	1,062
35.	MacDowell	36,300	44.0	825

MAXIMUM PROBABLE FLOWS
BASED ON TWICE THE
STANDARD PROJECT FLOOD
(Flat and Coastal Areas)

River	SPF (cfs)	D.A. (sq. mi.)	MPF (cfs/sq. mi.)
1. Pawtuxet River	19,000	200	190
2. Mill River (R.I.)	8,500	34	500
3. Peters River (R.I.)	3,200	13	490
4. Kettle Brook	8,000	30	530
5. Sudbury River.	11,700	86	270
6. Indian Brook (Hopk.)	1,000	5.9	340
7. Charles River.	6,000	184	65
8. Blackstone River.	43,000	416	200
9. Quinebaug River	55,000	331	330


MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITE
DEC. 1977
M.P.F. IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES
3000
2500
2000
1500
1000
500
0
2
5
10
50
100
500
1000
MOUNTAINOUS
ROLLING
FLAT & COASTAL
x15
x4
x10
x2
x6
x14
x1
12x
3x
13x
28x
x25
x27
9x
34x
x26
x24
9x
x17
11
18x
x17
x20
16x
x29
30x
22x
x8
35x
x21
x32
x23
x33
31x
3'⊗
4'⊗
2
5'⊗
5⊗
9'⊗
2'⊗
8'⊗
7'⊗

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES



STEP 1: Determine Peak Inflow (Qp1) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass "Qp1".

b. Determine Volume of Surcharge (STOR1) In Inches of Runoff.

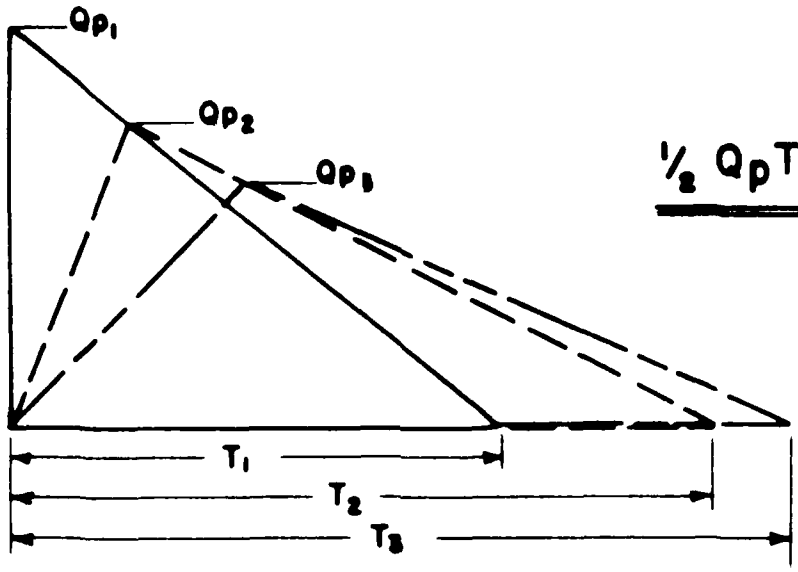
c. Maximum Probable Flood Runoff In New England equals Approx. 19", Therefor

$$Qp_2 = Qp_1 \times \left(1 - \frac{STOR_1}{19}\right)$$

STEP 3: a. Determine Surcharge Height and "STOR2" To Pass "Qp2"

b. Average "STOR1" and "STOR2" and Determine Average Surcharge and Resulting Peak Outflow "Qp3".

"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$\frac{1}{2} Q_p T = 12 S$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Qp_1 = \frac{8}{27} W_b \sqrt{g} Y_o^{\frac{3}{2}}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOPMANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Qp_2(\text{TRIAL}) = Qp_1 \left(1 - \frac{V_1}{S}\right)$$

C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Qp_2 = Qp_1 \left(1 - \frac{V_{ave}}{S}\right)$$

STEP 5: FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

APRIL 1978

HYDROLOGIC / HYDRAULIC INSPECTION

LAKE WINTERGREEN NEW HAVEN. CT

(1) MAXIMUM PROBABLE FLOOD - PEAK FLOW RATE

(a) WATERSHED CLASSIFIED AS "ROLLING". USE MPF "ROLLING" CURVE FURNISHED BY THE ACE, NEW ENGLAND DIV. OFFICE FOR THE DETERMINATION OF MPF

(b) WATERSHED AREA: D.A. = 1.4 SQ.MI (NEW HAVEN WATER CO. AUG. 19..
C.E. MEASURES 1.6 SQ. MI
USE D.A = 1.6 SQ. MI

(c) FROM GUIDE CURVE (EXTRAPOLATION)
MPF = 2,200 CFS / SQ. MI

(d) MPF = PEAK INFLOW
$Q = 2,200 \times 1.6 = 3,500$ CFS

(2) SPILLWAY DESIGN FLOOD (SDF)

(a) CLASSIFICATION OF DAM ACCORDING TO ACE GUIDELINES
(1) SIZE① (IMPOUNDMENT): STORAGE (MAX) = 540 Ac-Ft (SMALL)
HEIGHT (TO CREST) = 30 Ft (SMALL)

① From NEW HAVEN WATER Co. DATA, AUG 1974
RESERVOIR CAPACITY AT FLOWLINE = 100 MG ≈ 307 Ac-Ft
AREA AT FLOWLINE = 43.5 Ac
AREA AT TOP OF DAM ≈ 90 Ac (ESTIMATED FROM USGS QUAD SHEET)
AVE AREA ABOVE SPILLWAY ≈ 65 Ac
FREEBOARD SPILLWAY (ELEV * ± 242.8 MSL) TO TOP OF DAM (ELEV * ± 246.3 MSL) ≈ 3.5' * SEE NOTE P.2

HYDROLOGIC / HYDRAULIC INSPECTION
LAKE WINTERGREEN, NEW HAVEN, CT

(2) (CONT'd) SPILLWAY DESIGN FLOOD (SDF)

(a) CLASSIFICATION OF DAM ACCORDING TO ACE GUIDELINES

① ADDITIONAL STORAGE TO TOP OF DAM ≈ 65 x 3.5 ÷ 230 Ac-ft.
THEREFORE, MAXIMUM STORAGE ≈ 540 Ac-ft
(U.S. INVENTORY OF DAMS SHOWS MAX. STORAGE = 966 Ac-ft)

THEREFORE, THE DAM IS CLASSIFIED AS OF "SMALL" SIZE

NOTE: NEW HAVEN WATER Co. DATA GIVE ELEVATIONS IN NEW HAVEN DATUM (MEAN HIGH WATER). MSL (USCGS DATUM) ≡ NEW HAVEN (MHW) DATUM +3.31'

(ii) HAZARD POTENTIAL:
THE DAM IS RATED OF "HIGH" HAZARD POTENTIAL BECAUSE IT IS LOCATED U/S OF URBAN DEVELOPMENT ALONG WINTERGREEN BROOK AND THE WILBUR CROSS PKWY.

(iii) SDF
ACCORDING TO ACE GUIDELINES, FOR A DAM RATED HIGH HAZARD POTENTIAL AND SMALL SIZE. SDF SHALL BE FROM $\frac{1}{2}$ MPF TO MPF.
ASSUMING SDF = MPF = 3,500 CFS

(3) EFFECT OF SURCHARGE STORAGE IN MAXIMUM PROBABLE DISCHARGE
(a) PEAK INFLOW Q_{P_1} = SDF = 3,500 CFS
(b) SURCHARGE HEIGHT TO PASS Q_{P_1}
(i) ESTIMATE SURCHARGE ABOVE SPILLWAY CREST
(SEE SHEET WITH SPILLWAY DIMENSIONS)
ASSUME SPILLWAY DISCHARGE COEFFICIENT C ≈ 2.7

HYDROLOGIC / HYDRAULIC INSPECTION

LAKE WINTERGREEN, NEW HAVEN, CT

(3) (CONT'D) EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES

(b) SURCHARGE HEIGHT TO PASS Q_{p1}

(i) ESTIMATE SURCHARGE ABOVE SPILLWAY CREST

LENGTH $L = 47.9'$ (C.E. SURVEYED DIMENSION JUNE, 1978)

$$Q \approx (2.7)(47.9) H^{3/2} \approx 130 H^{3/2}$$

$\therefore$ @ $Q_{p1} \approx 3{,}500$ CFS

$H \approx 9.0'$

FREEBOARD (SPILLWAY TO CREST) $= 3.5'$ (NEW HAVEN WATER CO. AUG, 1974)

HENCE, THE DAM IS OVERTOPPED. SPILLWAY CAPACITY AT $H = 3.5'$, $Q \approx 850$ CFS

(ii) COMPUTE TRUE SURCHARGE ABOVE SPILLWAY CREST

TOTAL LENGTH OF DAM $= \pm 900'$ (NEW HAVEN WATER CO. AUG, 1974)

LENGTH OF DAM $= \pm 852'$ (C.E. SURVEYED DIMENSION JUNE, 1978)

ASSUME TOTAL LENGTH OF DAM ($\pm 850'$) AND NORTHERN SIDE SPILL $\approx 900'$ ASSUME $C \approx 2.7$

$$\therefore Q \approx 130 H^{3/2} + 2400 (H - 3.5)^{3/2}$$

THEREFORE

@ $Q_{p1} \approx 3{,}500$ CFS

$H_1 \approx 4.5'$

HYDROLOGIC / HYDRAULIC INSPECTION

LAKE WINTERGREEN, NEW HAVEN CT

(3) (CONT'd) EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES

(c) VOLUME OF SURCHARGE

AVE. RESERVOIR AREA (SEE P. 1) ≈ 65 Ac.

ASSUME NORMAL POOL 0.5' ABOVE SPILLWAY CREST

∴ VOL. OF SURCHARGE.

$65 \times (4.5 - 0.5) \approx 260$ Ac-ft

D.A. = 1.6 SQ. MI

$S_1 = \frac{260}{1.6 \cdot 533}$

$= 3.0"$

(d) PEAK OUTFLOW FOR SURCHARGE S_1

NOTE: GUIDELINE FOR ASSUMING A TRIANGULAR HYDROGRAPH AND MPF RUNOFF IN NED IS ± 19")

$$Q_{p2} = Q_{p1}\left(1 - \frac{S_1}{19}\right)$$

$$Q_{p2} = 3{,}500\left(1 - \frac{3}{19}\right)$$

$\approx 2{,}950$ CFS

FOR $Q_{p2} = 2{,}950$ CFS

$H_2 \approx 4.3'$

$S_2 \approx 2.9"$

$S_{AVE} \approx 2.9"$

HYDROLOGIC / HYDRAULIC INSPECTION

LAKE WINTERGREEN, NEW HAVEN CT

(3) Cont'd) EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES

(e) RESULTING PEAK OUTFLOW.

$$Qp_3 = 3,500 \left(1 - \frac{2.9}{19}\right)$$

$$Qp_3 \cong 3,000 \text{ CFS}$$

$$H_3 \cong 4.3'$$

(f) SUMMARY.

FOR PEAK INFLOW Qp_1 = MPF - 3,500 CFS

PEAK OUTFLOW QD_2 = 3,000 CFS

AVERAGE SURCHARGE = ±4.3' ABOVE THE SPILLWAY CREST DAM IS OVERTOPPED BY A DEPTH OF ±0.8'

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Project INSPECTION OF NON-FEDERAL DAMS IN NEW ENGLAND — Sheet 1 of 4
Computed By D. SHEN — Checked By [illegible] — Date 6/5/1978
Field Book Ref ____ — Other Refs (E#27-531-GE — Revisions ____

HYDROLOGIC/HYDRAULIC INSPECTION
LAKE WINTERGREEN, NEW HAVEN. CT
DOWNSTREAM FAILURE HYDROGRAPH

(I) ESTIMATE OF D/S FAILURE HYDROGRAPHS
(SEE ACE "RULE OF THUMB" GUIDELINES FOR ESTIMATING THESE HYDROGRAPHS")

(II) ESTIMATE OF RESERVOIR STORAGE AT THE TIME OF FAILURE:
(SEE D. SHEN comps. 5/25/1978)

(i) MAXIMUM STORAGE CAPACITY : 540 Ac-ft

(ii) HEIGHT OF DAM ABOVE SPILLWAY ≅ 3.5'

(iii) AVERAGE AREA FOR SURCHARGE WATER LEVELS ABOVE THE SPILLWAY ≅ 65 Ac.

(iv) HEIGHT OF MAXIMUM POOL ≅ 30 ft.

(V) ESTIMATE RESERVOIR STORAGE AT TIME OF FAILURE. TO A SURCHARGE OF ≅ 4.3 ft ABOVE THE SPILLWAY OR ≅ 0.8 ft ABOVE THE DAM

$S \cong 540 + 65(0.8) \cong 590$ Ac-ft

$\frac{S}{2} \cong 295$ Ac-ft

D12

HYDROLOGIC / HYDRAULIC INSPECTION

LAKE WINTERGREEN, NEW HAVEN CT

DOWNSTREAM DAM FAILURE HAZARD

(1) (CONT'D) ESTIMATE OF DOWNSTREAM DAM FAILURE HYDROGRAPH

(b) PEAK FAILURE OUTFLOW Q_{p1}

(i) BREACH WIDTH:

TOTAL LENGTH OF THE DAM INCLUDING SPILLWAY IS ± 700 FT.

HENCE, MAXIMUM BREACH AT APPROXIMATELY THE MID-HEIGHT. (LENGTH = ± 700')

$$W \cong 0.4 \times 700$$
$$\cong 280'$$

∴ TAKE $W_b \cong \underline{280'}$

(ii) TOTAL HEIGHT AT FAILURE

USE INFO. FROM NEW HAVEN WATER CO. AUG 1974

HEIGHT OF CREST FROM BED OF BROOK 30 FT

∴ TOTAL HEIGHT $Y_o \cong 30 + 0.8 \cong \underline{30.8'}$

(iii) PEAK FAILURE OUTFLOW:

$$Q_{p1} = \frac{8}{27} W_b \sqrt{g}\, y_o^{1.5} \cong \underline{80{,}400 \text{ CFS}}$$

(iv) APPROX. FLOOD WAVE HEIGHT IMMEDIATE D/S OF DAM SITE.

$$y \cong 0.44\, y_o \cong 13.5'$$

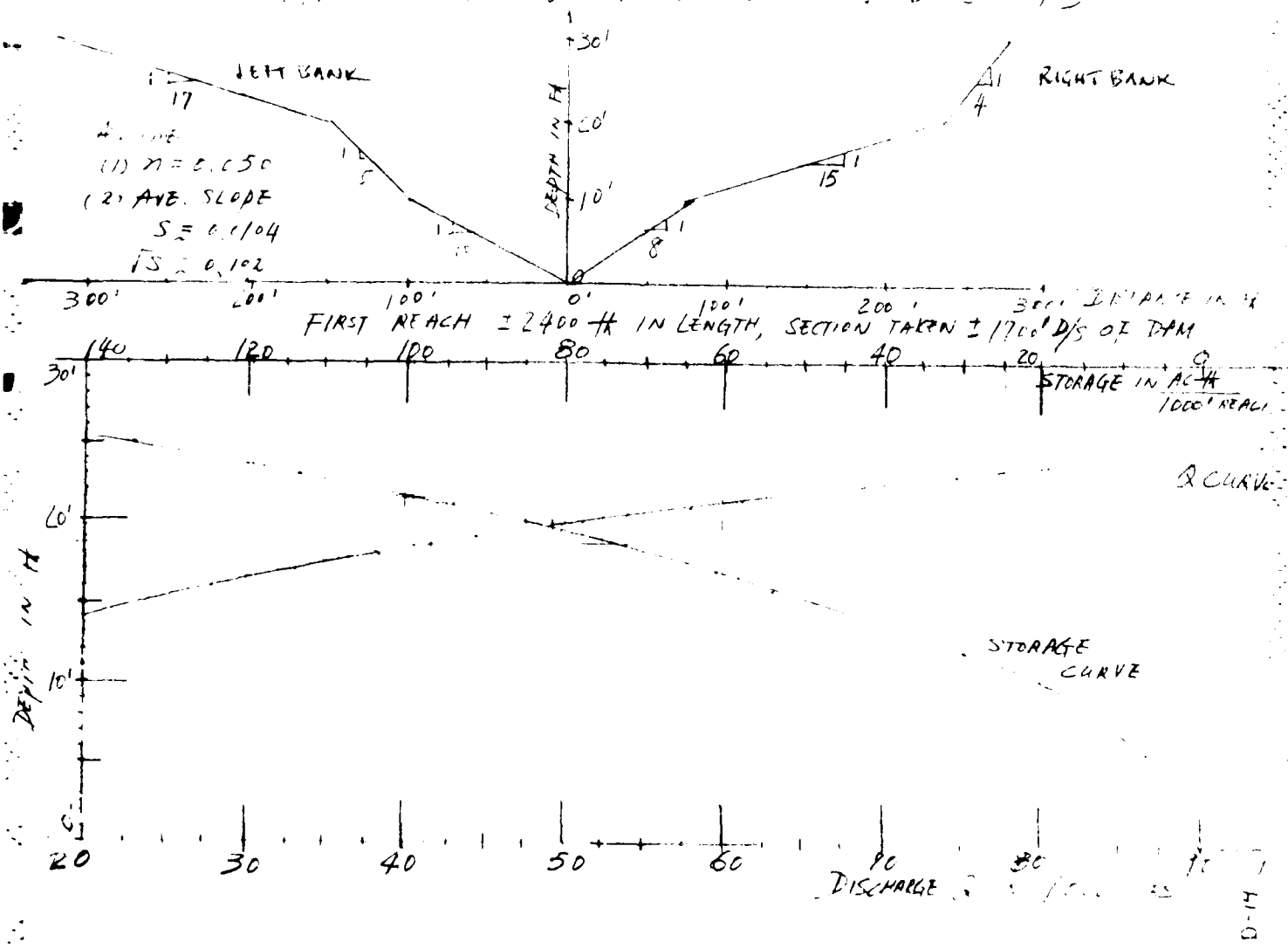
HYDROLOGIC / HYDRAULIC INSPECTION

LAKE WINTERGREEN NEW HAVEN, CT

DOWNSTREAM DAM FAILURE HAZARD

(b) (CONT'D) ESTIMATE OF D/S DAM FAILURE HYDROGRAPHS

(c) TYPICAL D/S CROSS-SECTION AND RATING CURVE
(FROM USGS NEW HAVEN QUADRANGLE SHEET)



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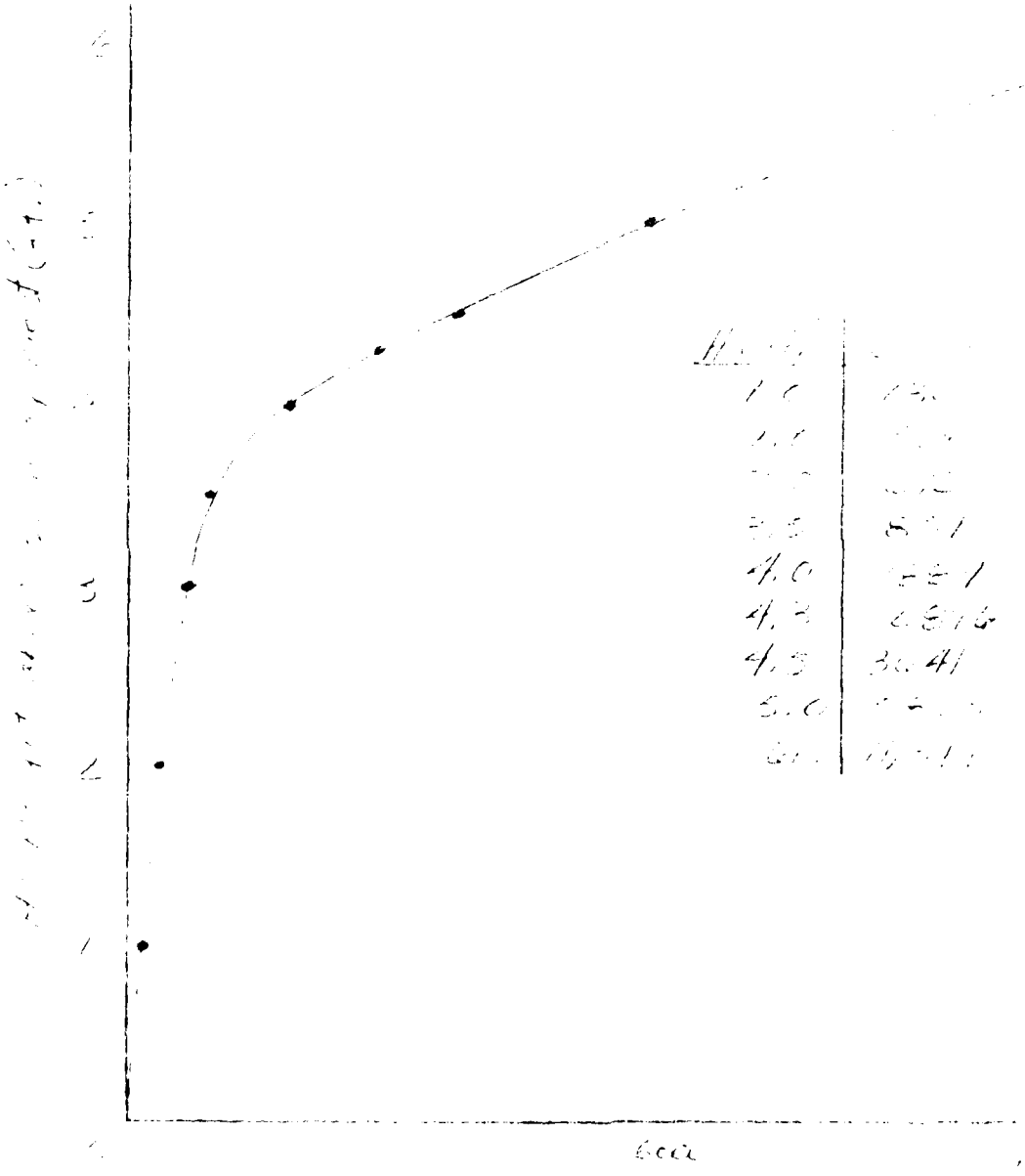
Project _____ Sheet 1 of 1

Computed By _____ Checked By _____ Date _____

Field Book Ref _____ Other Refs _____ Revisions _____



1.0	
1.2	
1.4	
1.6	
1.8	
2.0	
2.2	
2.4	
2.6	
2.8	
3.0	
3.2	

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Project [illegible]
Computed By [illegible]
Field Book Ref [illegible]
Date [illegible]
Revisions

[illegible]

LAKE [illegible]

DOWNSTREAM [illegible]

(1) FLOOD(S) ESTIMATE [illegible]

(d) REACH [illegible] S.L.

(i) @ Q_{p1} = 80,400 CFS [illegible] STAGE = 23.7
VOLUME IN REACH
V_1 = 119 × 2.4 = 285 Ac-ft < S/2 = 295 Ac-ft

(ii) Q_{p2} (TRIAL)
$Q_{p2} = Q_{p1}\left(1 - \frac{V_1}{S}\right) = 80{,}400\left(1 - \frac{285}{590}\right) \simeq 41{,}600$ CFS

(iii) @ Q_{p2} = 41,600 CFS, STAGE ≃ 18.6'
V_2 = 73 × 2.4 = 175 Ac-ft

V_{AVE} ≃ 230 Ac-ft

(iv) $Q_{p2} = Q_{p1}\left(1 - \frac{V_{AVE}}{S}\right) = 80{,}400\left(1 - \frac{230}{590}\right)$
≃ 49,100 CFS
STAGE ≃ 19.7' SAY 20'

(e) Summary:
PEAK FAILURE OUTFLOW Q_{p1} = 80,400 CFS
PEAK REACH OUTFLOW Q_{p2} = 49,100 CFS
AVG. STAGE IN REACH ≃ 20 ft

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Project INSPECTION OF NON FEDERAL DAM IN NEW ENGLAND | Sheet 1 of 3
Computed By DSPER | Checked By [illegible] | Date 6/15/1978
Field Book Ref | Other Refs CE # 27-531-GE | Revisions

HYDROLOGIC / HYDRAULIC INSPECTION

LAKE WINTERGREEN NEW HAVEN CT

(A) MPF ESTIMATE FROM HIGH INTENSITY RAINFALL PERIOD OF A SHORT DURATION STORM IN A SMALL WATERSHED

THIS PARALLEL COMPUTATION IS MADE CONSIDERING THAT FOR SMALL DRAINAGE AREAS, USE BY EXTRAPOLATION OF THE MPF GUIDE CURVES FURNISHED BY THE ACE, NEW ENGLAND DIVISION, MAY GIVE PEAK RUNOFFS OF LESSER MAGNITUDE THAN THOSE WHICH COULD PROBABLY OCCUR

ASSUME FOR WINTERGREEN, A TIME OF CONCENTRATION OF ABOUT 1-HR, AS THE HIGH INTENSITY RAINFALL PERIOD FOR ESTIMATING THE MAXIMUM PROBABLE RUN-OFF

(a) 6-HR PMP AT LAKE WINTERGREEN : PMP = 24.5"
(10 SQ MI - PT RAINFALL

FROM USBR "DESIGN OF SMALL DAMS" - FIG 1, P.27 BASED ON HYDROMETEOROLOGICAL REPORT NO 33 - US WEATHER BUREAU US CORPS OF ENGINEERS)

(b) ASSUME MOST INTENSE 1-HR PERIOD RAINFALL ≃ 51% OF THE TOTAL 6-HR RAINFALL.

HENCE

PMP FOR 1-HR PERIOD AT WINTERGREEN ≃ 12.5"/HR

(c) ASSUME PMF FOR THIS DA ≃ 70% OF THE ABOVE PMP, OR

PMP ≃ 8.8"/HR

Qp = 1.6 × 8.8 × 645.3 = 9100 CFS

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Project INSPECTION OF NON FEDERAL DAMS IN NEW ENGLAND Sheet 2 of 3
Computed By D.SHEN Checked By HW Date 6/15/1978
Field Book Ref _____ Other Refs CE#27-31-GE Revisions _____

HYDROLOGIC/HYDRAULIC INSPECTION

LAKE WINTERGREEN, NEW HAVEN CT (CONT'D)

(2A) THE DAM IS CLASSIFIED AS SMALL WITH HIGH HAZARD POTENTIAL
∴ SDF RECOMMENDED BY ACE GUIDELINES $\frac{1}{2}$ PMF TO PMF
∴ ASSUME SDF = PMF = 9,100 CFS (PEAK INFLOW)

(3A) EFFECT OF SURCHARGE STORAGE ON MAX. PROBABLE DISCHARGES

(a) FOR Q_{p_1} = 9,100 CFS (see D.SHEN 5/25/78 comps p3.)
@ Q_{p_1} = 9,100 CFS
$H_1 \doteq 5.6'$ (DAM OVERTOPPED BY ± 2.1')

(b) VOL. OF SURCHARGE @ $H_1 \doteq 5.6'$
$V_1 = 65(5.6 - 0.5) \doteq 331.5$ AC-FT, SAY 331 AC-FT
∴ $S_1 = \frac{331}{1.6 \times 53.3} \doteq 3.9"$

(C) ASSUMING THE PMF FLOOD RUNOFF IN NEW ENGLAND (SEE GUIDELINES) APPROX. EQUAL TO 19", AND THE RUNOFF IN 6-HR TO BE 83% OF THE 24 HR RUNOFF THE PEAK OUTFLOW CAN BE ESTIMATED AS FOLLOWS (SEE GUIDELINES)

$0.83 \times 19 \doteq 15.8"$

$Q_{p_2} = Q_{p_1}\left(1 - \frac{S_1}{15.8}\right)$

$Q_{p_2} \doteq 9,100\left(1 - \frac{3.9}{15.8}\right)$

$\doteq 6,860$ CFS

SAY $Q_{p_2} \doteq 6,900$ CFS, $H_2 \doteq 5.2'$

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Project INSPECTION OF [illegible] DAMS IN NEW ENGLAND Sheet 3 of 5
Computed By D.S.H.A. Checked By [illegible] Date [illegible]
Field Book Ref Other Refs CE#27-531-GE Revisions

HYDROLOGIC / HYDRAULIC INSPECTION

LAKE WINTERGREEN, NEW HAVEN CT

3A (CONT'D) EFFECT OF SURCHARGE ON MAX PROBABLE DISCHARGES

(d) $V_2 = 65 \cdot (5.2 - 0.5) = 305.5$ Ac-ft
SAY 305 Ac-ft

$S_2 \approx 3.6"$

SAVG = 3.75"

(e) RESULTING PEAK OUTFLOW (Qp_3) AND AVG SURCHARGE (H_3)

$Qp_3 \approx 9{,}100 \left(1 - \frac{3.75}{15.8}\right) = 6900$ CFS

$H_3 \approx 5.2'$

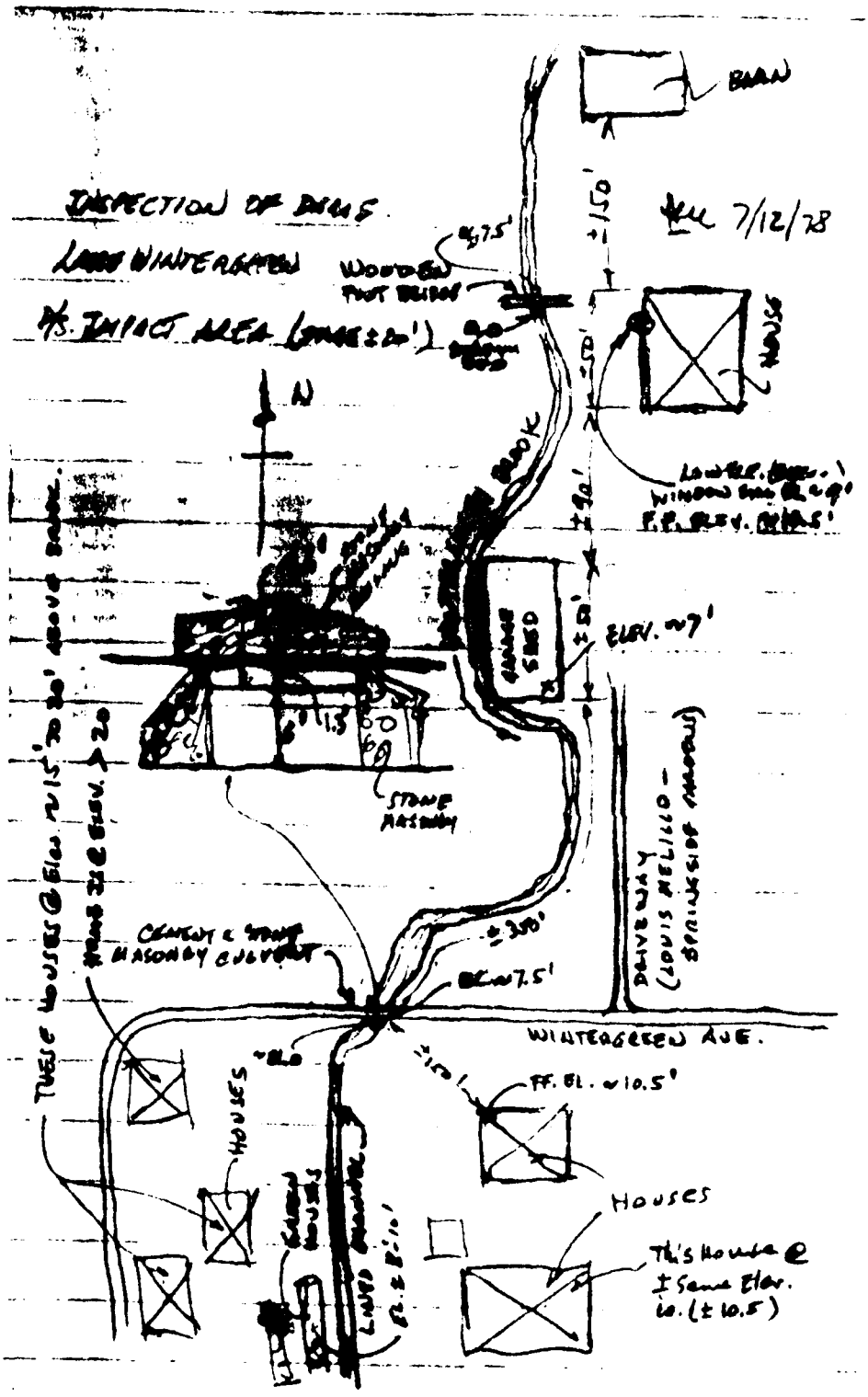
(f) Summary.

PEAK INFLOW $Qp_1 \approx MPF = 9{,}100$ CFS

PEAK OUTFLOW $Qp_3 \approx 6{,}900$ CFS

AVG SURCHARGE $H_3 \approx 5.2'$ (DAM IS OVERTOPPED)

DAM OVERTOPPED BY ± 1.7'


INSPECTION OF DAMS
LOCUST WINTERGREEN
% IMPACT AREA (OTHER ± 2')
BARN
WOODEN FOOT BRIDGE
HOUSE
N
BROOK
STONE MASONRY
ELEV. ±7'
DRIVEWAY
(LOUIS MELILLO - SPRINKLER MANUAL)
± 300'
WINTERGREEN AVE.
HOUSES
FF. EL. ±10.5'
Houses
This House @ ± Same Elev. 10. (± 10.5)

NOTE:

THESE COMPUTATIONS HAVE BEEN PERFORMED BASED UPON A DAM BREACH WITH A SURCHARGED WATER SURFACE ELEVATION. IN ACCORDANCE WITH NORMAL CORPS PROCEDURES, COMPUTATIONS ARE PERFORMED BASED UPON A WATER SURFACE ELEVATION AT THE TOP OF THE DAM. A DAM BREACH WITH THE WATER SURFACE AT THE TOP OF THE DAM AND WITHOUT HEAVY DOWN-STREAM CHANNEL FLOW COULD BE MORE CRITICAL THAN A DAM BREACH WITH A SURCHARGE. THE DIFFERENCE, IN THIS CASE, IS NOT SUBSTANTIAL.

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY | MO | YR
CT	118	NED	CT	009	03				LAKE WINTERGREEN DAM	4121.2	7256.1	08SEP78

POPULAR NAME	NAME OF IMPOUNDMENT
	LAKE WINTERGREEN

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	07	WINTERGREEN BROOK	NEW HAVEN	2	135400

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	INSPECTION DIST	OWNER	FED REGULATED	PRIVATE/FEDERAL	STATE REGULATED	STATE AGENCY	VERIFICATION DATE
REGRPG	1863	S	31	31	540	307	NED	N	N	N	N		25AUG78

REMARKS

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	900	U	50	850												

OWNER	ENGINEERING BY	CONSTRUCTION BY
NEW HAVEN WATER CO		

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
CAHN ENGINEERS INC	06JUN78	PL 92-367

REMARKS

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